

A Single Dose of 0.75% Epidural Ropivacaine is ideal for Lower Limb Orthopedic Surgeries - Quashing the Myth

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ABSTRACT

Background and Aim: The efficiency of 0.75% Ropivacaine as a single shot epidural anaesthetic in comparison to 0.5% Bupivacaine has been widely studied and proven to be a safer alternative to the later. The present study aim was to focus on the impact of motor blockade with Ropivacaine on long duration lower limb orthopedic surgeries.

Materials and Methods: The present study was done with 0.75% Ropivacaine and 0.5% Bupivacaine in epidural anaesthesia in lower limb orthopedic surgeries given as a single shot technique in eighty patients of ASA I/II and divided to two groups of forty each and fifteen milliliters of the drug given. Duration of surgery was calculated as the difference between the administration of epidural anaesthesia and the last suture of the surgical wound. Onset of the motor blockade with Modified Bromage scale I and regression to Scale 0 was assessed and thus duration of motor blockade of epidural anaesthesia was calculated individually in group R and group B respectively.

Results: Onset of motor blockade was faster in group R than in group B and regression was faster in group R than in group B. Also, intensity of block was greater in Group B.

Conclusion: It can be concluded that duration of motor block in epidural anaesthesia was shorter and less intense with 0.75% Ropivacaine than 0.5% Bupivacaine, in which group surgeries outran anaesthesia.

Keywords: Epidural Anaesthesia, 0.75% ropivacaine, 0.5% bupivacaine, lower limb orthopedic surgeries

INTRODUCTION

India is a fractured society, not metaphorically, but in the physical sense. India hobbles to second place in hip fractures with 4.4 lakh people falling prey every year according to Asian Audit, by the International Osteoporosis Foundation.^[1] Also, utilization rates for total hip arthroplasty and total knee arthroplasty have increased over the last two-three decades. With aging population and increased longevity, the TKA and THA

utilization rates are projected to increase even further.^[2]

Thus, based on many studies, it can be conveniently said that orthopedic lower limb surgeries are on the rise and the requirement of adequate sensory and motor relaxation during the surgery for the same becomes the top most priority to enable faster and easier recovery of the cases.

Orthopedic surgeries take up the fourth position with respect to intraoperative duration after head and neck,

cardiovascular and plastic surgeries.^[3] Hip arthroplasties, knee arthroplasties, arthroscopies, carcinomas and various other orthopedic surgeries are of very long duration.

Regional Anaesthesia has always been the best form of anaesthesia in orthopedic surgeries and epidural anaesthesia has been considered as the modality of choice because of its ability to be prolonged to suit the duration of intraoperative period and postoperative pain management.^[4]

Conventionally 0.5% Bupivacaine has been used in epidural anaesthesia but because of its cardiotoxicity, anaesthesiologists found a safer alternative in ropivacaine which has been found to be primarily cardiosafe and comparable to bupivacaine.^[5] In a 0.5% concentration, ropivacaine provides comparable sensory blockade and inferior motor blockade to 0.5% bupivacaine.^[6,7]

Various studies done comparing 0.75% ropivacaine versus 0.5% Bupivacaine showed the superior sensory blockade of ropivacaine over bupivacaine but emphasized very little on the quality of motor blockade of ropivacaine.

In our institute, there are an average of 100-120 orthopedic elective surgeries per month out of which 75-80% are lower limb surgeries.

The present study focuses on assessing the motor blockade of 15ml 0.75% Ropivacaine versus 15ml 0.5% Bupivacaine given as a single dose in detail and determining this effect on the intraoperative performance of anaesthesia.

MATERIALS AND METHODS

The present study was done as a prospective, randomized, comparative one in 80 patients aged between 22 to 79 years involving both sexes belonging to ASA grade I and II scheduled for elective Orthopedic lower limb surgeries. After obtaining approval for the study from Institute ethics Committee, CAIMS, Karimnagar and written consent was obtained from all the patients. They were randomly divided into two groups. Group B-(n=40) were given 0.5% Bupivacaine Hydrochloride 15ml given by epidural technique. Group R-(n=40) were given 0.75% Ropivacaine Hydrochloride 15ml given epidurally.

Inclusion criteria

All patients posted for Elective Orthopaedic lower limb surgeries (All arthroplasty surgeries, all revision arthroplasties, all arthroscopy surgeries, all fractures and all carcinomas) under ASA Grade I and II including both males and females.

Exclusion criteria

- Patients who are unwilling to give consent
- ASA Grade III, IV, V or E
- Obese patients
- Patients with uncontrollable hypertension
- Patients with uncontrollable diabetes mellitus
- Patients with severe CVS abnormalities (ischaemic heart disease, valvular heart disease, AV conduction blocks, CCF)
- Patients with endocrine disturbances including deranged thyroid function tests
- Patients with a H/O epilepsy or those taking anti-epileptics
- Patients with renal or hepatic failure
- Patients with H/O head injuries or neurological surgeries
- Patients with spine deformities
- Patients with coagulation defects, those on anti-coagulants, those with H/O viral fevers with thrombocytopenia

All patients were evaluated by pre anaesthetic checkup on the day before surgery. On the day of surgery, the patients were shifted to the OR and were randomly assigned to Group B or Group R.

Baseline vital hemodynamic parameters such as heart rate, non-invasive arterial blood pressure, oxygen saturation and ECG were noted. Intravenous line was secured with an 18G intravenous catheter and intravenous fluids were connected. Preloading was done with 500 ml of Ringer's Lactate. Premedication was given with I.V. Ondansetron 4mg. The patient is put in sitting position and under strict aseptic conditions, local anaesthetic is injected in L3-L4 space followed by Tuohy needle with a loss of resistance syringe.

On confirmation of loss of resistance, the catheter is threaded 5cms cephalad in the epidural space and secured accordingly. 15cc of 0.75% Ropivacaine in group R and 15cc of 0.5% Bupivacaine in group B are given in the epidural catheter.

Variables measured –onset of motor block assessed with Bromage scale 1, depth of maximum motor blockade is assessed by bromage scale after 30 minutes of initial drug injection, endpoint of motor blockade is assessed by return of bromage scale. Vital parameter monitoring was done periodically and were maintained within normal limits. The motor recovery was recognised by muscle twitches and contractions to manipulations in the surgical site and inability to achieve reduction of the bone at the surgical site in case of fractures and arthroplasties. In such cases, induction of General Anaesthesia followed by Intubation was the Rescue Protocol.

Modified Bromage Scale

- 0: No motor block
- 1: Inability to raise extended leg; able to move knees and feet
- 2: Inability to raise extended leg and move knee; able to move feet
- 3: Complete block of motor limb

Sample size calculation with a significance level of 95%, power of study 80%, a error of 0.05 and β error of 0.2 and to show a 20% difference in the duration of motor blockade, at least 30 patients per group were needed.

In the present study, 40 patients were taken per group to compensate for any drop-outs. Duration of motor blockade was analyzed by the student t-test.

For categorical covariates (sex, age, ASA grade) the comparison was done using a chi-square test or Fisher’s exact test. The significance level was defined as $P < 0.001$. Data were expressed as mean \pm SD. The Statistical software namely Open Epi, Version 2.3 was used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Table 1: Comparison of demographic parameters

	Group R		Group B		p-Value
Age (Mean \pm SD)	55.76 \pm 14.68		56.8 \pm 15.49		0.7744
Sex	Males - 24	Females - 16	Males - 19	Females - 21	-
ASA Grade	Grade I - 17	Grade II - 23	Grade I - 12	Grade II - 28	-

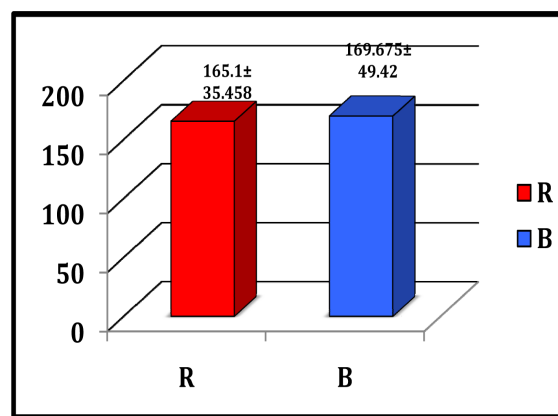
Table 2: Comparison of duration of surgery

Group R (mins)	Group B (mins)	p-Value
165.1 \pm 35.458	169.675 \pm 49.42	0.04104

Demographic parameters like age, sex distribution and ASA grade were comparable in the both groups.

RESULTS

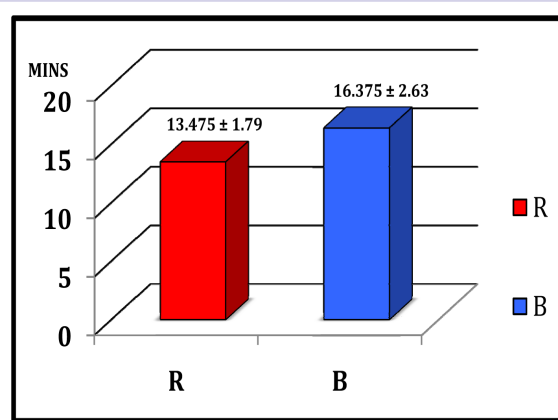
The duration of surgery was measured from the time of administration of epidural anaesthesia to the last suture of the surgical wound. It was found to be 165.1 \pm 35.458 minutes in Group R and 169.675 \pm 49.42 minutes in Group



Graph 1: Comparison of duration of surgery.

Table 3: Comparison of motor onset at Bromage scale 1

Group R (Mins)	Group B (Mins)	p-Value
13.475 \pm 1.79	16.275 \pm 2.63	0.01831



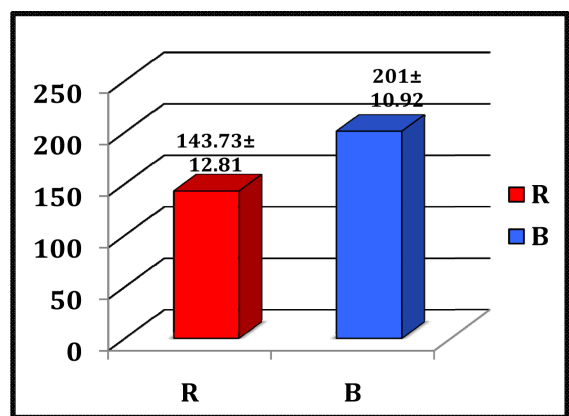
Graph 2: Comparison of motor onset at Bromage scale 1.

B which was statistically insignificant with a p-Value of 0.04104 (Table 2).

The onset of motor blockade with Bromage scale I was observed at 13.475 \pm 1.79 minutes in Group R whereas it was observed at 16.375 \pm 2.63 minutes in Group B, leading to the observation that onset of motor blockade was of faster onset in 0.75% Ropivacaine group but with a p-value of 0.01831 which is insignificant, implying that though there was faster onset in Group R, it is not statistically significant (Table 3).

Table 4: Comparison of motor duration (Return to Bromage 0)

Group R (Mins)	Group B (Mins)	p-Value
143.73 ± 12.81	201 ± 10.92	<0.0000001



Graph 3: Comparison of motor duration.

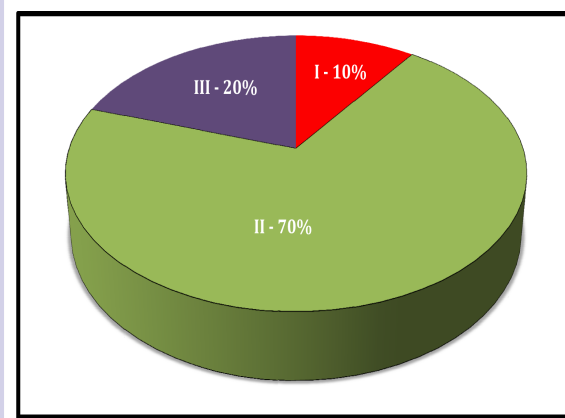
As mentioned earlier, the time taken for the motor blockade to regress to Bromage Scale 0 from the attainment of the Bromage Scale 1 was taken as the duration of the motor block. It was 143.73±12.81 minutes in Group R and 201±10.92 minutes in Group B with a significant p-Value of <0.0000001. This shows that the motor block duration in 0.75% Ropivacaine group was significantly less than that of 0.5% Bupivacaine group (Table 4).

Table 5 : Comparison of depth of motor block

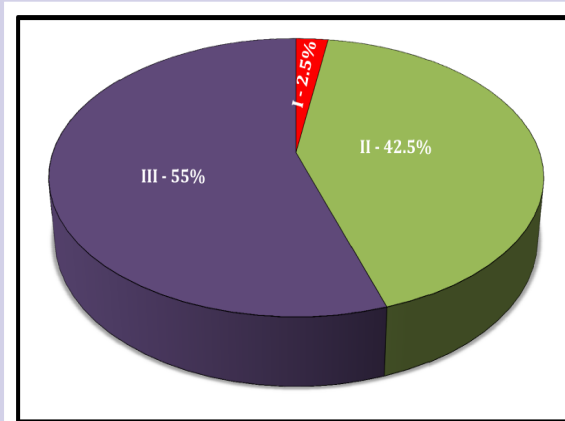
Bromage Scale	Group R	%	Group B	%
0	0	0	0	0
1	4	10	1	2.5
2	28	70	17	42.5
3	8	20	22	55

Depth of motor block which was assessed by Modified Bromage scale was represented as percentage of subjects in each scale and compared thereafter.

All the patients in 0.75% Ropivacaine group attained motor block with 10% of them with scale I, 70% in scale II and 20% in Scale III. Similarly all patients in 0.5% Bupivacaine group attained motor block with only 2.5% in Scale I, 42.5% in Scale II and 55% in Scale III (Table 5).



Graph 4 a: Depth of motor block (% Ropivacaine).



Graph 4b: Depth of motor block (% Bupivacaine).

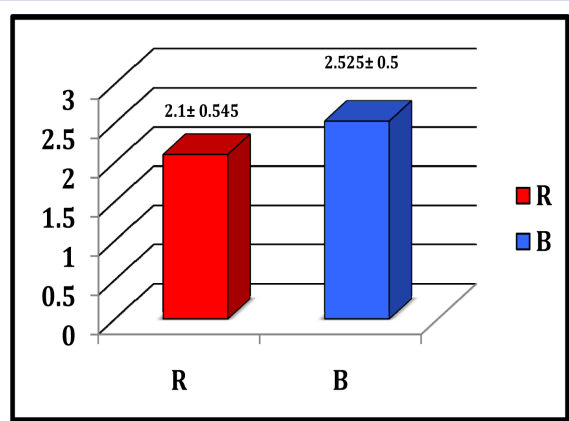
Table 6: Comparison of depth of motor block (Average Bromage Scale)

Group R	Group B	p-Value
2.1±0.545	2.5±0.5	0.9094

The depth of motor blockade was also described as an average of Modified Bromage scale which was statistically insignificant with a p-Value of 0.9094 though the average of Ropivacaine was less than that of bupivacaine derived as 2.1±0.545 and 2.5±0.5 respectively (Table 6).

Table 7: Comparison of Implementation of Rescue protocol

Group R (No)	%	Group B (No)	%	p-Value
4	10	0	0	0.0000001



Graph 5: Depth of motor block (Average Bromage Scale).

Induction of general anaesthesia followed by intubation was carried out as a rescue protocol in 4 cases in Group R which is 10% of the study group whereas it was 0 in Group B which is statistically significant (Table 7).

DISCUSSION

There have been various studies comparing the efficacy of 0.75% Ropivacaine versus 0.5% Bupivacaine. Almost all the studies have reiterated the fact that 0.75% Ropivacaine is a safer alternative to 0.5% Bupivacaine in terms of toxicity, better on the sensory blockade front and has a lesser motor impact. It can be used in almost all the lower limb orthopedic surgeries when administered epidurally.

The present study focuses on the inadequate motor block attained in epidural 0.75% ropivacaine leading to hindrance in most orthopedic surgeries due to inappropriate muscle relaxation. The duration of most orthopedic surgeries in the present study was 165.1±35.458 minutes which outran the average duration of the motor block of 0.75% ropivacaine which was 143.73 ± 12.81minutes. Also, the depth of the motor blockade with 0.75% Ropivacaine was relatively less when compared to 0.5% Bupivacaine.

The percentage of patients who attained Scale III were a mere 20% in 0.75% Ropivacaine as compared to 55% with Bupivacaine. It was 70% in Scale II in Group R whereas it was just 42.5% in Group B. Also, there were as many as 10% patients in Scale I in Group R in comparison to just 2.5% in Group B. Though the sensory component lasted more than that of motor blockade, it still presented as a festering problem for the surgery to continue.

In 4 cases of Ropivacaine group, where it became impossible to continue surgery inspite of continuing sensory blockade, induction of General Anaesthesia

followed by intubation was done to facilitate completion of the surgery.

In the present study, there was a faster onset of motor blockade with 0.75% Ropivacaine than with 0.5% Bupivacaine which differed with almost all the studies done earlier including a study by Shah Ushma D et al,^[9] Brockway MS et al,^[10] who found that bupivacaine had a faster onset of motor blockade and Chandran S et al,^[11] Bjornestad, E. et al^[12] found that onset time for ropivacaine was comparable with that of Bupivacaine and there was no significant difference between the two.

The present study has deduced that the duration of motor blockade is less in Ropivacaine in comparison to Bupivacaine which was in concurrence with earlier studies done by C. Geetha et al,^[13] S Shaik et al,^[14] Patil et al,^[15] Brockway MS et al,^[10] Whereas the present study's inference varied with studies done by Chandran S et al,^[11] Korula S et al,^[16] Bjornestad, E., et al^[12] who inferred that duration of motor blockade was similar with both Ropivacaine and Bupivacaine.

The depth of the motor blockade was determined in two methods (i) by the percentage of patients in each scale measured by using Modified Bromage scale at 30 minutes from epidural drug administration (ii) by calculating the average Bromage Scale in each group.

In both the methods, the present study inferred that the intensity of motor blockade was less in Ropivacaine than in Bupivacaine, proving that 0.5% Bupivacaine has a greater intense motor blockade when compared with 0.75% Ropivacaine. This tallied with earlier studies done by MS Brockway et al,^[10], C. Geetha et al,^[13] S Shaikh et al,^[14] Korula S et al,^[16] who stated that intensity of motor blockade was greater with Bupivacaine than Ropivacaine. Thus it is safe to say that the motor component of 0.75% epidural Ropivacaine is inferior to 0.5% epidural Bupivacaine.

The present study has observed that in long duration lower limb orthopedic cases, a single loading dose of 15ml 0.75% Ropivacaine given epidurally, though produces the required amount of sensory blockade with sufficient duration, has been unsuccessful in attaining the required and significant amount of motor blockade in terms of duration and depth as well resulting in intubation to facilitate the continuation and completion of the surgery in 10% of the cases. This observation has not been reported hither to.

CONCLUSION

Thus, for long standing orthopedic lower limb surgeries, 0.75% Ropivacaine is a wholesome alternative achieving same level of sensory blockade and pharmacologically safer even in higher doses compared to 0.5% Bupivacaine,

but it remains unsuccessful on the motor front. It would always be a good approach to look for an alternative to 0.75% ropivacaine which would be similar to it in all aspects but for the better motor blockade.

CONFLICT OF INTEREST:

The authors declared no conflict of interest.

FUNDING: None

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